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AUTHOR Kindig, L. E.; Mrvos, S. R.
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ABSTRACT

Guidelines are offered for the prevention and relief of lower back pain. The structure of the spine is described, and the functions and composition of spinal disks are explained. A list is included of common causes of abnormalities of the spinal column, and injuries which may cause the fracture of the vertebrae are described. Factors causing low back distress are listed, including insufficient flexibility, leg length discrepancy, habitual posture faults, and lack of abdominal muscle strength. A questionnaire is included which may help an individual to identify the likelihood of backache and health factors which could cause problems. Exercises are described which will test muscles for strength and flexibility and also prevent back pain. Drawings of the structure of the spinal column are included, as well as the movements in the preventive exercises.
(JD)

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Coping with Low Back Pain

L. E. Kindig and S. R. Mrvos
Department of Physical Education
University of Georgia

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Introduction

One in three adults have back pain each day (Finneson, 1975). An estimated 80 percent of the population will have an episode of low back pain at some time in their life (Kelsey and White, 1980). Back pain is second to the common cold as a cause for absenteeism in the work force (Finneson, 1975). The National Safety Council reported that 20,000 claims for back injuries are paid annually by the Workmen's Compensation Board and 400,000 workers have back pain (Macnab, 1977). Mayer estimated that work-incurred back pain costs \$14 billion annually (Vert, 1983).

From these statistics, one can readily see that the probability for back pain is high and the cost is great. If you have or have had back pain, you have famous company. John Kennedy, Barry Goldwater, Elizabeth Taylor, and Jack Nicklaus were victims of back problems. Even Garfield suffered for about a week (Figure 1).

Back pain is not a modern phenomenon. The Neanderthal man located near Dusseldorf, Germany, estimated to be 100,000 years old, had a spine that was deformed with arthritis. Hippocrates treated backache with manipulation and salicylate acids that are similar to those in aspirin (Finneson, 1975). Modern medical techniques have helped with diagnosis and treatment, but backache has not been eliminated. In fact, sedentary lifestyle, weekend sport and household activities, on-the-job stress, and even the intensive training for athletes, make present-day adults as vulnerable to back problems as the hard life of the Neanderthal man and our ancestors who labored to develop

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our great land. The two-legged (biped) posture of the homo sapien lies at the root of our problems. The biped posture will not change and, therefore, the best defense against back pain is an understanding of the structure in relation to habitual postures, work and recreation, tissue changes, and muscles that support the spine.

Structure of the Spine

Because of the biped posture of man, there are natural curves in the spine (Figure 2). The convex curves are forward in the cervical and lumbar spine, whereas, the forward aspect of the thoracic spine is concave. The lumbar spine bears most of the body weight and is subject to the shock of running, walking and jumping. Therefore, it is the lumbar spine that is most vulnerable to stress and, hence, to injury.

The disks between the vertebrae are the shock absorbers and also provide the mobility of the spine (Figure 3). At the center of the disk is the nucleus pulposus which is a loose network of fibrous tissue within a gelatinous substance, 90% of which is water. During the aging process the water content drops to about 70% which makes it more dense and fibrous. The nucleus is enveloped in concentric rings of fibrocartilage called the annulus fibrosus. The annulus is thinner and less firm on the posterior aspect than on the anterior aspect. When one bends, a portion of the annulus protrudes beyond the adjacent vertebrae (Figure 3). The protrusion frequently occurs toward the posterior or toward the weaker side of the annulus. Although this is the weak side, still it is very strong. In the healthy young adult, the vertebral disk will deform only under pressures of about 1400 pounds whereas it will deform in older persons at about 350 pounds of pressure. Slipped disks or herniated disks in young people show loss of water and, hence,



Figure 2. Natural curves of the spine.

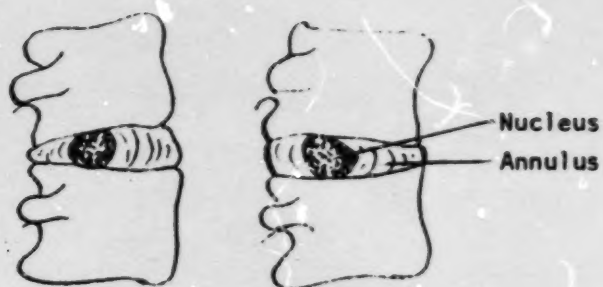


Figure 3. Disks between lumbar vertebra with normal protrusion of annulus fibrous.

premature aging. The disks are not weak. In fact, during severe stress, such as a fall on the ice, the vertebrae will fracture before the healthy disk gives away (Finneson, 1975).

Heavy work does not necessarily cause ruptured disks. Many persons habitually lift heavy loads without disks problems and yet a sedentary worker can slip a disk by leaning over to pick up a paper clip. This mechanical stress causes the nucleus to squeeze through a weakened annulus. If the extruded portion is toward the back, it frequently pushes against a spinal nerve pressing it against the protective bone (Figure 4). This causes sciatica characterized by pain or numbness in the low back, back of the leg and sometimes in the foot.

Causes of Backache

Backache may be caused by structural abnormalities, diseases, serious injuries, psychological stress, or strain that results from mechanical problems. Backaches are usually the result of mechanical problems (Hcworth, 1983), but since most persons have insufficient knowledge to identify the etiology of pain, the wise backache sufferer will seek a medical diagnosis of the problem before he or she embarks on an exercise program. Certainly if there is acute or persistent backache, one should consult a physician before exercising.

The purpose of this presentation is to emphasize causes of back pain over which an individual has some control. However, it is well to mention other common causes so that the importance of a medical examination is re-emphasized:

1. Injuries -- violent forces (falls, heavy loads descending of the shoulders or back, automobile accidents, collisions in sports) may fracture a vertebrae.

2. Diseases

- a. Osteoarthritis: This degenerative condition is commonly associated

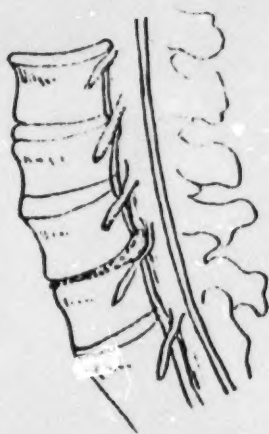


Figure 4. Protrusion of disk against sciatic nerve.

with disc degeneration and may be hastened by violent jolts and twists, a sedentary lifestyle, and poor circulation that is abetted by obesity and use of tobacco and alcohol.

- b. **Young Executive Syndrome:** The discs are susceptible to psychological stress. Among persons under stress, the discs have been shown, both microscopically and biomechanically, to lose elasticity and to become degenerate (Helfet, 1978). This condition is increasing in urban populations for those age 35-45.
- c. **Rheumatoid Arthritis:** Inflammation of the spinal joints is uncommon, but often affects young adults and sometimes children.
- d. **Tuberculosis:** Tuberculous infection sometimes affected the discs prior to 1940. Although it is uncommon in the United States and Europe today, it is still common in the developing countries.
- e. **Infections:** Germs can cause osteomyelitis (bone infection) and joint infection (suppurative arthritis). These conditions require medical diagnosis and treatment.
- f. **Tumors:** Both benign and malignant tumors must be treated by a physician.
- g. **Referred pain:** Back pain can be caused by problems at other sites on the anatomy. Even ulcers can cause backache.

3. Structural Abnormalities (Howorth, 1983)

- a. **Spina bifida:** This is usually a congenital condition characterized by abnormality in the bony structure of the vertebrae.
- b. **Spondylolysis:** A gap exists between the articular projections of the vertebrae. By the age of 10 years 4 percent of Americans have this condition. Spondylolysis may be caused or aggravated by back bends as in gymnastics or acrobatics. The condition may also be inherited.

If both parents have spondylolysis, the incidence in their children is increased by 50 percent.

- c. Sciatica: Pain radiates into the buttock, thigh, or calf because of irritation or pressure on one of the roots of the sciatic nerve as it leaves the spine. Sciatica often results when one or more of the discs rupture or protrude. Low back pain usually precedes sciatica by months or even years and almost always accompanies sciatica.
- d. Scoliosis: Lateral curvature of the spine may cause backache, stiffness, disability, fast fatigue and osteoarthritis (Figure 5).
- e. Acute Angle of the Sacrum (lordosis): The sacrum tilts forward and downward at an angle of 10 to 70 degrees (Figure 6). An angle of approximately 40 degrees is considered normal. As the angle becomes more acute, the shearing effects and sliding strain increase. The strain on the lumbar joints are increased by postural problems.

Conditions which may increase sacral tilt include:

- 1. Knee hyperextension (back knee) (see Figure 7)
- 2. Kyphosis (round back) (see Figure 7)
- 3. Pregnancy (see Figure 7)
- 4. Obesity (see Figure 7)
- 5. Weak abdominals (see Figure 8)

These conditions, except pregnancy, can be avoided if one is willing to spend time, patience, and effort. Pregnancy would be less problematic if the other conditions were avoided.

Caring for the Back

Howorth (1983) designed a questionnaire to predict the likelihood of problems if you do not already have backache. If you have backache, your answers may help to identify factors that could cause your problems.



Figure 5. Scoliosis of the spine.

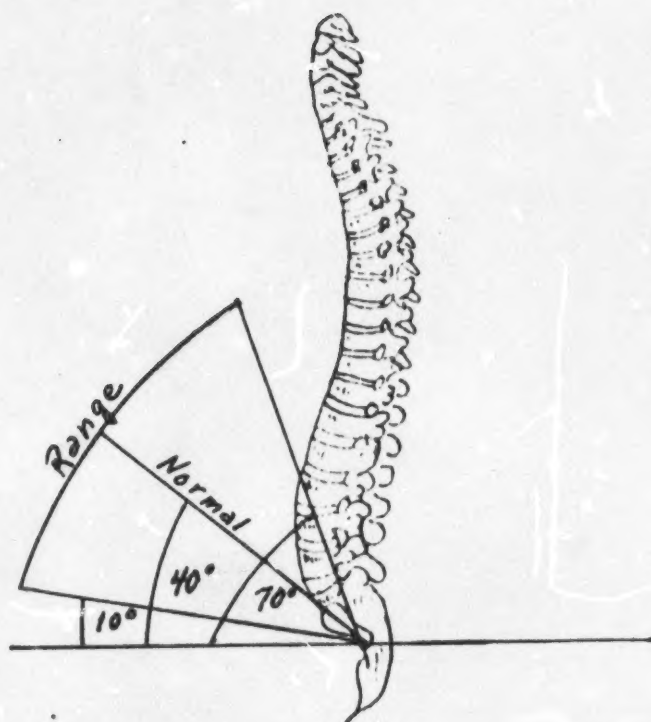
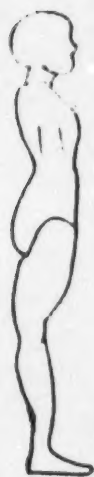


Figure 6. Angle of sacrum: the more acute the angle, the more stress on the lumbar spine.



Knee hyperextension



Kyphosis

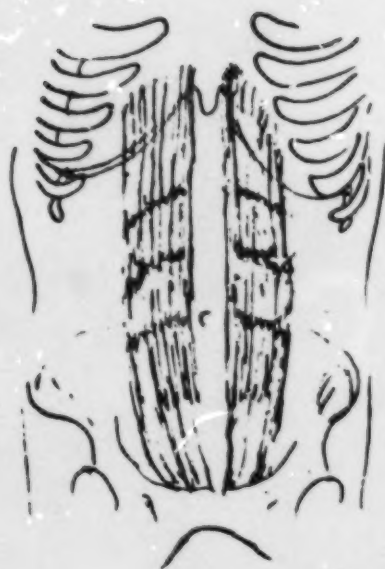


Pregnancy

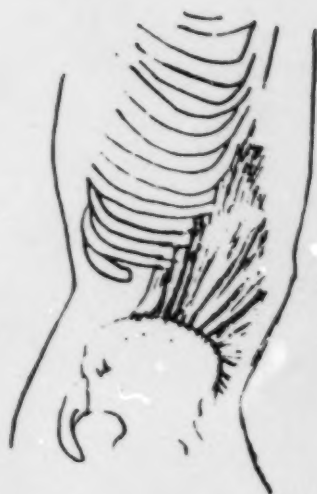


Obesity

Figure 7. Conditions that cause acute sacral tilt.



Rectus Abdominis



Internal Oblique



External Oblique

Figure 8. Abdominal muscles that support the spine.

QUESTIONNAIRE TO PREDICT BACK PROBLEM

DIRECTIONS: Please answer Yes or No to the following questions. Your answers will not be collected. They are for your appraisal only.

<u>YES</u>	<u>NO</u>	
—	—	GENERAL HEALTH
—	—	1. Are you ten or more pounds overweight?
—	—	2. Do you drink alcohol daily?
—	—	3. Do you take tranquilizing drugs?
—	—	4. Do you smoke tobacco?
—	—	POSTURE, EXERCISE, AND FITNESS
—	—	5. Do you (or other people) consider your posture poor?
—	—	6. Do you slump in chairs or sit in a half-lying position?
—	—	7. Does your occupation mean that you engage in only occasional or slight physical activity during the week?
—	—	8. Are you physically more active on weekends than on weekdays?
—	—	9. Do you follow a program of adequate regular exercise?
—	—	LIFESTYLE
—	—	10. Do you wear high heels, sneakers, or loafers most of the time?
—	—	11. Do you sleep on a soft mattress?
—	—	12. Are you often tired and/or depressed?

¹Source: Beckett Howorth, Cure Your Own Backache. Jackson, Miss. University Press of Mississippi, 1983, p. 5.

Responses of no to question 9 and yes to all others indicate that your chances are great for having a backache at some time in your life. If you responded yes to any two questions under General Health, yes to question 7 and yes to some of the questions under lifestyle, you still run a relatively high risk of backache. Status related to one question may influence the status related to another question so that actually one is caught in a "predisposition to backache syndrome." For example, the more tired and depressed, the more likely one is to use alcohol, tobacco, and tranquilizers which in turn may increase a weight problem and leads to less enthusiasm for a regular exercise program--all of which leads to greater fatigue and depression. A similar chain of events could be cited for depression and posture.

If you have ever been a victim of low back pain that is not the result of a disease, structural abnormality, or traumatic injury, you should accept the fact that you must rethink your lifestyle if you wish to be pain-free. Exercise can be the secret to prevention of low back pain. Howarth (1983), a physician who wrote a simple book entitled Cure Your Own Backache, devoted one-third of the space to exercise. Not only can exercises help to control weight, but they can also improve flexibility in the pelvic region and strengthen the muscles that support the spine.

Testing Your Muscles for Strength and Flexibility (Finneson, 1975)

The exercises below will indicate if you have strength and flexibility deficiencies. Even if you can perform the exercises, strength and flexibility can be maintained or improved with a planned exercise program. You should check with your physician or have a relatively pain-free back before attempting these exercises.

Abdominal strength

1. Lie flat on your back, hands behind neck, and knees straight.

Lift your legs 12 inches off the floor and hold this position

for 10 seconds. If you can do this, your lower abdominal strength is normal.

2. Assume the same position and have someone hold your feet down. If you can do one situp, you have normal upper abdominal strength.

Lumbar strength

1. Lie flat on your stomach with a pillow under your stomach. Lift your chest off the surface and hold this position for 10 seconds. Ability to perform this exercise indicates that you have normal upper back strength.
2. Lie in the same position and lift your legs off the surface. If you can hold for 10 seconds, you have normal lower back strength.

Lumbar and hamstring flexibility

Stand erect. Bend forward and touch your fingers to the floor with the knee straight. Using 24 inches as a standard, fingertips 18 inches from the floor indicates a 75% deficiency, 12 inches indicates a 50% deficiency, etc.

Exercises for Prevention of Back Pain

The exercises included in the Appendix are designed to improve flexibility and to strengthen the muscle groups that support your back. Contrary to a popular myth, backache is usually associated with weak abdominals, not weak back muscles. In most exercises designed for prevention of back pain, the low back (lumbar spine) should be kept flat (Figure 9). If the lower spine comes off the floor (Figure 9A) during an exercise, that exercise is too difficult and should be stopped until you can perform it with a flat back (Figure 9B).

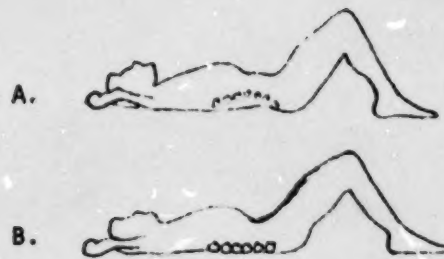


Figure 9. Flat back position for back exercises.
Keep the back flat as illustrated in B.

Secrets to Prevention of Low Back Pain

In the absence of disease and structural abnormalities, a few simple precautions in daily living habits can reduce the chances of backache. One should also assess the hazards which are specific to employment. For example, typewriter and computer keyboards positioned at proper heights and distances from the operator are essential for good sitting posture.

1. Maintain good low-back posture. Prevent lordosis (sway back).
2. If you must stand for long periods of time, place one foot on an 8 inch stool. Alternate feet. If use of a stool is not practical, lean forward on your hands. Use any technique to prevent sway back.
3. Avoid wearing high heels for long periods of standing and walking. High heels increase lumbar curve.
4. Sit in a straight chair with a firm seat and back. Your knees should be level with the hips. If they are not, the lumbar curve will be increased.
5. Sleep on a firm mattress, perhaps with a board between the mattress and springs. Sleeping on the side with your knees pulled up is the best posture for the low back.
6. Drive an automobile with your seat pulled up so that the knees are higher than the hips. Get out of the car and stretch every hour or two. Seat belts help to maintain good driving posture.
7. Lifting is hazardous.
 - a. Use your legs to lift.
 - b. Do not twist when carrying a heavy load.
 - c. Keep the object close to the body. Avoid reaching out to lift, such as raising the window over the sink or lifting something out of the back seat of the car.

8. Recognize your limits and learn to live with them. Remember that your back becomes more vulnerable to injury with each passing day (aging). The lumbar spine's resistance to pressure is reduced by 20% per decade after age 30. Disks lose fluid (70% for old disks compared to 90% for young disks) and become flatter. Vertebrae lose calcium, but exercise helps to maintain mineral level. More warm-up is required to keep tendons and ligaments flexible. Finneson (1975) recommended 40-50 minutes of warm-up for oldsters, compared to 20-30 minutes for young people, before jogging or engaging in strenuous activities.
9. Avoid sporadic bouts of intensive physical activity. Sports and household chores only on weekends or vacations can be hazardous to your back!
10. Engage in regular exercise (at least 3 times per week) designed to maintain the strength of the abdominal muscles and to maintain flexibility of the pelvic girdle.

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APPENDIX

EXERCISES FOR PREVENTION OF LOW BACK PROBLEMS

S. R. Mrvos and L. E. Kindig
 Department of Physical Education
 University of Georgia
 Athens, GA. 30602

Approximately 80 percent of the population will experience low back pain at some time during their life. A variety of factors may cause the low back distress: leg length discrepancy, anatomical structure problems, habitual postural faults, insufficient flexibility, and lack of abdominal strength. Flexibility and abdominal strength are the two factors every individual should attend each day. Too often, however, exercise prescribers fail to recognize the value of simple exercises that could prevent or alleviate low back distress. Furthermore, exercises which emphasize hyperextension of the low back are of questionable value and should be avoided in general exercise programs for most populations.

The following exercises were designed to include in a general conditioning program to help prevent low back problems. Lower abdominal strength and upper leg strength as well as pelvic girdle flexibility are emphasized. CAUTION: If an individual has low back pain, a physician should be consulted before engaging in these exercises.

Use these exercises prudently. Few persons who are beginning an exercise program will be able to complete the entire series. You should stop if they cannot prevent lumbar hyperextension. Notice that the cervical spine is flexed in most exercises to help prevent lumbar hyperextension. For beginners, the number of repetitions may be reduced and you may wish to omit exercises 8 - 11. Reserve the three minute test (#32) for the third or fourth week, depending on the level of conditioning. Increase the load gradually. Highly conditioned persons can perform the series in approximately 15 minutes once they have learned the series, but some persons may never achieve that standard. Modify the series to the abilities of the performers.

IMPORTANT TO NOTE: Throughout these exercises -

1. The head is off the floor in all supine and side lying exercises. Neck flexion in the supine position ensures that the small of the back is flat against the floor. If the small of the back comes off the floor, the exercises are potentially harmful and should be stopped.
2. Keep the legs straight with the toes pointed to ensure that upper legs and abdominals are worked maximally.
3. You should feel contraction in the abdominals and upper legs.

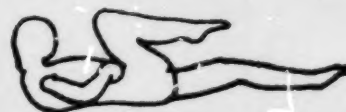
1. Hip and Knee Flexion. Hands folded over chest; bring right knee to chest in 5 counts. Repeat 10 times. Repeat with left leg.



2. Hip and Knee Flexion, Straight Leg Lowering. Bring right knee to chest; extend leg and lower slowly. Repeat 10 times. Repeat with left leg.



3. Running or Bicycling. Run in space; two leg cycles in 5 counts. Repeat 10 times.



4. Leg Crossovers for Flexibility. Raise right leg and rotate it over extended left leg; bounce 5 times. Repeat 10 times. Repeat with left leg.



5. Double Leg Hip and Knee Flexion. Bring knees to chest, grasp knees, flex spine, blow out air; continue to hold legs and allow head to touch floor and inhale. Then lift head and pull on knees. Repeat 10 times.



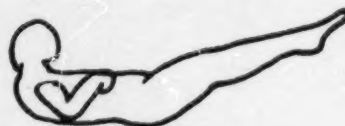
6. Double Leg Hip and Knee Flexion and Leg Extension.
Bring knees to chest and grasp knees, extend legs; lower legs but don't let them touch floor.
Repeat 10 times.



7. Straight One-Leg Raise.
Bring right leg up and lower slowly, legs straight and toes pointed. 10 times.
Repeat with left leg.



8. Straight Double-Leg Raise.
Lift both legs; lower slowly. 10 times.



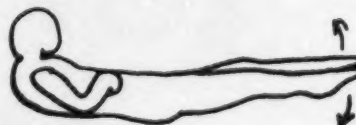
9. Flutter Kick.
Hold legs off floor; flutter kick in air, 6 counts. 10 repetitions. (60 flutters).



10. Leg Spread. Raise right leg off floor; swing sideward (Abduct); return (Adduct). Repeat 10 times. Repeat with left leg.



11. Double Leg Spread.
Hold legs off floor. Abduct and Adduct both legs. Repeat 10 times.



12. Side Lying Top-Leg Raise.
Support head; Abduct and lower right leg. Repeat 10 times.



13. Side-Lying Bottom-Leg Raise.
Place flexed right leg behind
extended bottom leg. Raise
bottom leg.
Repeat 10 times.



14. Side-Lying Double-Leg Raise.
Raise both legs to 6
counts and lower to floor.
Repeat 10 times.



15. Side-Lying Top-Leg Hip and
Knee Flexion.
Bring top knee to chest;
Extend.
10 times.



16. Side-Lying Bottom Leg Hips
and Knee Flexion.
Place top leg behind bottom
leg with foot behind knee;
bring bottom leg to chest;
Extend. 10 times.



17. Side-Lying Double Leg Hip and
Knee Flexion.
Bring both legs to chest;
Extend. 10 times.



18. Side-Lying Running.
Run in space with hip
and knee flexion."
10 times.



19. Side-Lying Hip Flexion and
Extension Top Leg.
With the bottom leg straight,
swing the top leg forward
and backward.
10 times.



20. Side-Lying Hip Flexion and
Extension Bottom Leg.
Hold the top leg up so
that the bottom leg is
free to swing forward and
backward as in 19.
10 times.



21. Side-Lying Flutter Kick.
 Raise legs off floor; flutter
 kick with leg straight to
 6 counts.
 (60 flutters).



22.-31. Repeat 12-21 on other side.

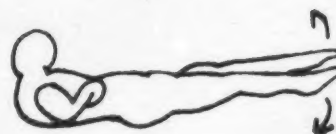
32. 3-Minute Test on Back (tests upper thigh and lower abdominal strength).
 Keep legs off floor with head up and perform in sets of 6 counts, 10 reps.
 Running (60); 6 counts, 10 reps. Flutters; 6 counts, 10 reps. Leg
 spreads (Abduction-Adduction). Keep the legs off the floor throughout
 the set of three exercises. Do not rest between exercises within a set or
 between sets of three. **CAUTION.** When the back cannot be held flat against
 the floor, **STOP** - You have reached your limit - There's always tomorrow.
HINT: Raise the head higher to keep the back against the floor.



Running 60 Times



Flutter 60 Times



Leg Spreads 60 Times

Performance Rating.

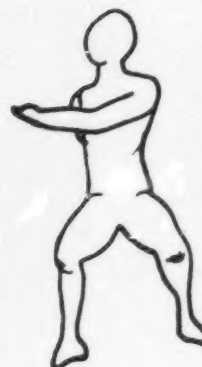
Less Than 1 Set	-	Poor
1 - 2 Sets	-	Good
2 - 3 Sets	-	Above Average
3 or More Sets	-	Excellent

- 33.-35. Warm Down with Stretching.

33. Standing - Side Trunk Flexion.
 With the knees extended, and body erect, gently bounce to right 5 times and then to left 5 times. Repeat 10 times.



34. Standing - Rotation of Trunk.
 From an erect standing posture. Rotate trunk from waist (keep head and shoulders level) so that you see the wall behind you. 5 count. Return to front. Repeat 10 times. Repeat to left 5 counts, 10 times.



35. Standing - Forward Flexion and Back Extension.
 Keep head up, spine erect and hands on hips. Lean forward and bounce gently 5 times, and return to erect position. Lean back and bounce gently 5 times, and return to erect position. Repeat 10 times.

